CLAIMS

1. An optical system for extracting signal light components from a beam including the signal light components and stray light components, the optical system comprising:

a condensing optical element situated on an optical path of the beam for condensing the beam;

a polarization changing unit for changing the state of polarization of at least one of the signal light components and the stray light components included in the incident beam transmitted through the condensing optical element; and

an extracting element for extracting the signal light components included in the beam transmitted through the polarization changing unit.

2. The optical system as claimed in claim 1,

wherein the polarization changing unit includes first and second polarization changing elements;

wherein the first and second polarization changing elements each include first and second areas that are divided by a line perpendicularly intersecting with the optical axis of the condensing optical element;

wherein the first polarization changing element is positioned between a first focus point and a second focus point that is situated closer to the condensing optical element than

the first focus point;

wherein the first focus point is a position at which the signal light components are condensed, and the second focus point is a position at which the stray light components are condensed;

wherein the second polarization changing element is positioned between the first focus point and a third focus point that is situated closer to the extracting element than the first focus point, the third focus point being another position at which the stray light components are condensed.

3. The optical system as claimed in claim 2,

wherein the first polarization changing element has an optical characteristic of changing the polarization of the beam incident on at least one of the first area and the second area of the first polarization changing element;

wherein the second polarization changing element has a same optical characteristic as the optical characteristic of the first polarization changing element.

4. The optical system as claimed in claim 3, wherein the polarization changing unit is configured to change the state of polarization of at least one of the signal light components and the stray light components included in the incident beam by providing a phase difference to the incident beam;

wherein the total of the phase difference provided to the incident beam at the first area of the first polarization changing element and the phase difference provided to the incident beam at the second area of the second polarization changing element is at least one of 0 wavelength and 1/2 wavelength.

5. The optical system as claimed in claim 4, wherein the first polarization changing element provides a phase change of +1/4 wavelength to the incident beam at the first area of the first polarization changing element and provides a phase difference of -1/4 wavelength to the incident beam at the second area of the first polarization changing element.

6. The optical system as claimed in claim 4, wherein the first polarization changing element provides a phase change of +1/2 wavelength to the incident beam at the first area of the first polarization changing element and provides no phase difference to the incident beam at the second area of the first polarization changing element.

7. The optical system as claimed in claim 3, wherein the polarization changing unit is configured to change the state of polarization of at least one of the signal light components and the stray light components included in the incident beam by

rotating the polarization direction of the incident beam,

wherein the first polarization changing element rotates the polarization direction of the incident beam at the first area of the first polarization changing element to an angle of +45 degrees and rotates the polarization direction of the incident beam at the second area of the first polarization changing element to an angle of -45 degrees.

8. The optical system as claimed in claim 1,

wherein the polarization changing unit includes first and second polarization changing elements;

wherein the first and second polarization changing elements each include first and second areas that are divided by a line perpendicularly intersecting with the optical axis of the condensing optical element;

wherein the first and second areas have different optical characteristics;

wherein the first polarization changing element is positioned between a first focus point and a second focus point that is situated closer to the condensing optical element than the first focus point;

wherein the first focus point is a position at which the signal light components are condensed, and the second focus point is a position at which the stray light components are condensed;

wherein the second polarization changing element is positioned between the first focus point and a third focus point that is situated closer to the extracting element than the first focus point, the third focus point being another position at which the stray light components are condensed.

9. The optical system as claimed in claim 8,

wherein the first polarization changing element has an optical characteristic of changing the polarization of the beam incident on at least one of the first area and the second area of the first polarization changing element;

wherein the second polarization changing element has a same optical characteristic as the optical characteristic of the first polarization changing element.

10. The optical system as claimed in claim 9, wherein the polarization changing unit is configured to change the state of polarization of at least one of the signal light components and the stray light components included in the incident beam by providing a phase difference to the incident beam,

wherein the total of the phase difference provided to the incident beam at the first area of the first polarization changing element and the phase difference provided to the incident beam at the second area of the second polarization changing element is 0 wavelength or

1/2 wavelength.

11. The optical system as claimed in claim 10, wherein the first polarization changing element provides a phase change of +1/4 wavelength to the incident beam at the first area of the first polarization changing element and provides a phase difference of -1/4 wavelength to the incident beam at the second area of the first polarization changing element.

12. The optical system as claimed in claim 10, wherein the first polarization changing element provides a phase change of +1/2 wavelength to the incident beam at the first area of the first polarization changing element and provides no phase difference to the incident beam at the second area of the first polarization changing element.

13. The optical system as claimed in claim 8, wherein the polarization changing unit is configured to change the state of polarization of at least one of the signal light components and the stray light components included in the incident beam by rotating the polarization direction of the incident beam,

wherein the total of the rotation angle of the polarization direction of the incident beam at the first area of the first polarization changing element and the rotation angle of the polarization direction of the incident beam at the second

area of the second polarization changing element is +90 degrees or -90 degrees.

14. The optical system as claimed in claim 13, wherein the first polarization changing element rotates the polarization direction of the incident beam at the first area of the first polarization changing element to an angle of +45 degrees and rotates the polarization direction of the incident beam at the second area of the first polarization changing element to an angle of -45 degrees.

15. The optical system as claimed in claim 2, wherein the first and second polarization changing elements are formed as a united body via a transparent member having a refractive index greater than 1.

16. The optical system as claimed in claim 2, wherein the first polarization changing element, the second polarization changing element, and the extracting element are formed as a united body via a transparent member having a refractive index greater than 1.

17. The optical system as claimed in claim 2, wherein the first and second polarization changing elements are inclined with respect to the optical axis of the condensing optical element.

18. The optical system as claimed in claim 2, wherein the first polarization changing element, the second polarization changing element, and the extracting element are each situated on a plane of corresponding prisms.

19. The optical system as claimed in claim 18, wherein the corresponding prisms are formed as a united body.

20. An optical system for extracting signal light components from a beam including the signal light components and stray light components, the optical system comprising:

a condensing optical element situated on an optical path of the beam for condensing the beam;

a polarization changing unit including a combination of a polarization changing element and a reflecting part for changing the state of polarization of at least one of the signal light components and the stray light components included in the incident beam transmitted through the condensing optical element; and

an extracting element for extracting the signal light components included in the beam transmitted through the polarization changing unit.

21. The optical system as claimed in claim 20,

wherein the polarization changing element includes first and second areas that are divided by a line perpendicularly intersecting with the optical axis of the condensing optical element;

wherein the polarization changing element is positioned between a first focus point and a second focus point that is situated closer to the condensing optical element than the first focus point;

wherein the first focus point is a position at which the signal light components are condensed, and the second focus point is a position at which the stray light components are condensed;

wherein the reflecting part is positioned at the first focus point.

22. The optical system as claimed in claim 21,

wherein the polarization changing element has an optical characteristic of changing the polarization of the beam incident on at least one of the first area and the second area of the polarization changing element;

wherein the reflecting part has an optical characteristic of reflecting the beam from the first area of the polarization changing element to the second area of the

polarization changing element.

23. The optical system as claimed in claim 21, wherein the polarization changing element provides a phase change of +1/2 wavelength to the incident beam at the first area of the polarization changing element and provides no phase difference to the incident beam at the second area of the polarization changing element.

24. The optical system as claimed in claim 21, wherein the polarization changing element and the reflecting part are formed as a united body via a transparent member having a refractive index greater than 1.

25. The optical system as claimed in claim 21, further comprising a transparent member positioned between the first focus point and the second focus point, wherein the transparent member has a refractive index greater than 1.

26. An optical pickup apparatus comprising:

a light source for irradiating a beam;

an optical system including

an objective lens for condensing the beam to a target recording layer of an optical disk having a plurality of recording layers, and

the optical system as claimed in claim 2; and

an optical detecting system for generating signals in accordance with the amount of light of the extracted signal light components.

27. The optical pickup apparatus as claimed in claim 26, further comprising: a separating optical element positioned between the condensing optical element and the first polarization changing element;

wherein the separating optical element is inclined 45 degrees with respect to the optical axis of the condensing lens;

wherein the beam from the light source is incident on the condensing optical element via the separating optical element;

wherein the beam from the condensing optical element is incident on the objective lens.

28. The optical pickup apparatus as claimed in claim 26, wherein the dividing line for each of the first and second polarization changing elements extends in a direction corresponding to the tracking direction.

29. An optical pickup apparatus comprising:

a light source for irradiating a beam;

an optical system including

an objective lens for condensing the beam to a target recording layer of an optical disk having a plurality of recording layers;

the optical system as claimed in claim 20; and

an optical detecting system for generating signals in accordance with the amount of light of the extracted signal light components.

30. The optical pickup apparatus as claimed in claim 29, wherein the extracting element is a beam splitter situated on an optical path between the light source and the objective lens, wherein the condensing optical element is a coupling lens situated on an optical path between the beam splitter and the objective lens.

31. The optical pickup apparatus as claimed in claim 29, wherein the dividing line for the polarization changing element extends in a direction corresponding to the tracking direction.

32. An optical disk apparatus comprising:

the optical pickup apparatus as claimed in claim 26; and

a processing apparatus for reading out information recorded in the optical disk in accordance with the signals

generated by the optical detecting system.

33. An optical disk apparatus comprising:

the optical pickup apparatus as claimed in claim 29; and

a processing apparatus for reading out information recorded in the optical disk in accordance with the signals generated by the optical detecting system.

34. An optical system for extracting signal light components from a beam including the signal light components and stray light components, the optical system comprising:

a condensing optical element situated on an optical path of the beam for condensing the beam, the condensing optical element condensing the signal light components at a first focus point and the stray light components at a second focus point;

a first polarization changing element positioned between the condensing optical element and the second focus point that is situated closer to the condensing optical element than the first focus point, the first polarization changing element including first and second areas that are divided by a line perpendicularly intersecting with the optical axis of the condensing optical element, the first polarization changing element having an optical characteristic of changing the polarization direction of the beam incident on the first area to

an angle of 90 degrees;

a first separating element positioned between the first and second focus points, the first separating element being operable to reflect or absorb the stray light components condensed more toward the condensing optical element than the first focus point;

a second separating element positioned between the first focus point and a third focus point at which the stray light components transmitted through first separating element are condensed, the second separating element being operable to reflect or absorb the stray light components transmitted through the first separating element; and

a second polarization changing element including first and second areas that are divided by a line perpendicularly intersecting with the optical axis of the condensing optical element, the second polarization changing element having an optical characteristic of changing the polarization direction of the beam incident on at least one of the first area and the second area of the second polarization changing element to an angle of 90 degrees.

35. The optical system as claimed in claim 34, wherein the first polarization changing element provides a phase change of 1/2 wavelength to the incident beam at the first area of the first polarization changing element and provides no phase

difference to the incident beam at the second area of the first polarization changing element.

36. The optical system as claimed in claim 34, wherein the first and second separating elements are formed as a united body via a transparent member having a refractive index greater than 1.

37. The optical system as claimed in claim 34, further comprising: a transparent member positioned between the second focus point and the third focus point, the transparent member having a refractive index greater than 1.

38. The optical system as claimed in claim 34, wherein the first polarization changing element, the first separating element, the second separating element, and the second polarization changing element are formed as a united body via a transparent member having a refractive index greater than 1.

39. The optical system as claimed in claim 34, wherein the first and second separating elements are inclined with respect to the optical axis of the condensing optical element.

40. The optical system as claimed in claim 34, wherein the first polarization changing element is situated on

a plane of a first prism, wherein the first separating element is situated on a plane of a second prism, wherein the second separating element is situated on a plane of a third prism, wherein the second polarization changing element is situated on a plane of a fourth prism.

41. The optical system as claimed in claim 40, wherein the first to fourth prisms are formed as a united body.

42. An optical pickup apparatus comprising:

a light source for irradiating a beam;

an optical system including

an objective lens for condensing the beam to a target recording layer of an optical disk having a plurality of recording layers, and

the optical system as claimed in claim 34; and

an optical detecting system for generating signals in accordance with the amount of light of the extracted signal light components.

43. The optical pickup apparatus as claimed in claim 42, wherein the dividing line for each of the first and second polarization changing elements extends in a direction corresponding to the tracking direction.

44. An optical disk apparatus comprising:

the optical pickup apparatus as claimed in claim 42; and

a processing apparatus for reading out information recorded in the optical disk in accordance with the signals generated by the optical detecting system.

45. An optical pickup apparatus provided with a light source, a collimator lens, a detector and separating part, an objective lens, an optical detecting system, and an optical detector for recording and reading-out information to and from an optical disk having a plurality of layers, the optical pickup apparatus comprising:

a condensing optical element for condensing a beam reflected from the plural layers of the optical disk, the beam including a signal light beam Lm that is reflected from an m^{th} layer of the plural layers, a first stray light beam Lm+1 that is reflected from a $m+1^{th}$ layer of the plural layers, and a second stray light beam Lm-1 that is reflected from a $m-1^{th}$ layer of the plural layers, the signal light beam Lm being condensed at a first focus point fm, the first stray light beam Lm+1 being condensed at a second focus point fm+1, and the second stray light beam Lm-1 being condensed at a third focus point fm-1;

a front shielding part positioned between the first focus point fm and the second focus point fm+1 for shielding the

beam oriented to a first area; and

a rear shielding part positioned between the first focus point fm and the third focus point fm-1 for shielding the beam oriented to a second area;

wherein the first and second areas are divided by an optical axis of the condensing optical element.

46. An optical pickup apparatus provided with a light source, a collimator lens, a detector and separating part, an objective lens, an optical detecting system, and an optical detector for recording and reading-out information to and from an optical disk having a plurality of layers, the optical pickup apparatus comprising:

a condensing optical element for condensing a beam reflected from the plural layers of the optical disk, the beam including a signal light beam Lm that is reflected from an m^{th} layer of the plural layers, a first stray light beam Lm+1 that is reflected from a $m+1^{th}$ layer of the plural layers, and a second stray light beam Lm-1 that is reflected from a $m-1^{th}$ layer of the plural layers, the signal light beam Lm being condensed at a first focus point fm, the first stray light beam Lm+1 being condensed at a second focus point fm+1, and the second stray light beam Lm-1 being condensed at a third focus point fm-1;

a beam splitting part positioned closer to the condenser part than the second focus point fm+1 for splitting the

beam into first and second areas divided by an optical axis of the condensing optical element;

a front shielding part positioned between the first focus point fm and the second focus point fm+1 on the side of the first area for shielding the first stray light beam Lm+1; and

a rear shielding part positioned between the first focus point fm and the third focus point fm-1 on the side of the second area for shielding the second stray light beam Lm-1.

47. An optical pickup apparatus provided with a light source, a collimator lens, a detector and separating part, an objective lens, an optical detecting system, and an optical detector for recording and reading out information to and from an optical disk having a plurality of layers, the optical pickup apparatus comprising:

a condensing optical element for condensing a beam reflected from the plural layers of the optical disk, the beam including a signal light beam Lm that is reflected from an m^{th} layer of the plural layers, a first stray light beam Lm+1 that is reflected from a $m+1^{th}$ layer of the plural layers, and a second stray light beam Lm-1 that is reflected from a $m-1^{th}$ layer of the plural layers, the signal light beam Lm being condensed at a first focus point fm, the first stray light beam Lm+1 being condensed at a second focus point fm+1, and the second stray light beam Lm-1 being condensed at a third focus point fm-1;

a beam splitting part positioned between the first focus point fm and the second focus point fm+1 for splitting the beam into first and second areas divided by an optical axis of the condensing optical element; and

a shielding part positioned between the first focus point fm and the third focus point fm-1 for shielding the first stray light beam Lm+1 and the second stray light beam Lm-1.

48. The optical pickup apparatus as claimed in claim 47, wherein the beam splitting part includes a pair of optical wedges in which the thinner sides of the optical wedges are matched so that the optical wedges are symmetric to each other with respect to the optical axis of the condensing optical element.

49. The optical pickup apparatus as claimed in claim 47, wherein the beam splitting part includes a pair of optical wedges in which the thicker sides of the optical wedges are matched so that the optical wedges are symmetric to each other with respect to the optical axis of the condensing optical element.

50. The optical pickup apparatus as claimed in claim 48, wherein the beam splitting part and the shielding part are formed as a united body.

51. The optical pickup apparatus as claimed in claim

49, wherein the beam splitting part and the shielding part are formed as a united body.

52. The optical pickup apparatus as claimed in claim 47, wherein the beam splitting part includes a diffraction grating for providing different diffraction with respect to the first and second areas.

53. The optical pickup apparatus as claimed in claim 52, wherein the diffraction grating is configured to diffract the beam so that the diffracted beam is inverted.

54. The optical pickup apparatus as claimed in claim 53, wherein the diffraction grating and the shielding part are formed as a united body.

55. The optical pickup apparatus as claimed in claim 52, wherein the light source is situated at the focus point fm if the diffraction grating is not provided, wherein the light source irradiates a linearly polarized light in a direction that cannot be diffracted by the diffraction grating.

56. The optical pickup apparatus as claimed in claim 52, wherein the diffraction grating and the shielding part are formed as a united body.

57. The optical pickup apparatus as claimed in claim 52, wherein the diffraction grating, the shielding part, the light source, and the optical detector are formed as a united body.

58. The optical pickup apparatus as claimed in claim 45, further comprising: another condensing optical element provided in front of the optical detector, wherein the optical detector includes a part that is divided into two parts by a line parallel to the tracking direction.

59. The optical pickup apparatus as claimed in claim 45, wherein the optical detector includes a part that is divided by a line perpendicularly intersecting with the tracking direction.

60. The optical pickup apparatus as claimed in claim 46, further comprising: another condensing optical element provided in front of the optical detector with respect to a portion of the beam split by the beam splitting part, wherein the signal light beam condensed by the other condensing optical element is detected by the optical detecting part that includes a part divided into two parts by a line parallel to the tracking direction.

61. The optical pickup apparatus as claimed in claim

46, wherein in a case where no other condensing optical element is provided in front of the optical detecting part, the optical detecting part for detecting a portion of the beam split by the beam splitting part includes a part divided into two parts by a line parallel to the tracking direction.

62. The optical pickup apparatus as claimed in claim 46, further comprising: another condenser part provided in front of the optical detector for detecting a portion of the beam split by the beam splitting part via the other condenser part; and

another optical detector for detecting the another portion of the bundle of light split by the beam splitting part signal light.

63. An optical recording apparatus comprising:

the optical pickup apparatus as claimed in claim 45.

64. An optical reproduction apparatus comprising:

the optical pickup apparatus as claimed in claim 45.

65. An optical recording and reproduction apparatus comprising:

the optical pickup apparatus as claimed in claim 45.